C-A Unreviewed Safety Issue (USI) Form

Title of USI: Tandem Van de Graff MP6 Upgrade

Description of USI (use attachments if necessary):

See Attached

Title and Date of Relevant SAD: SAD for the TVDG Facility, November 28, 1995

Committee Chair or ESHQ Division Head must initial all items. Leave no blanks:

ITEM	APPLIES	DOES NOT APPLY
Decision to not revise the current SAD and/or ASE at this time:	ETL	
The hazard associated with the proposed work or event is covered within an existing SAD and/or ASE.	ETL	
SAD Title and Date: SAD for the TVDG, 11-28-95	ETL	
This Form and attachments, if necessary, shall be used to document the USI until the next revision of the appropriate SAD.	ETL	
Decision to submit a revised SAD and/or ASE to the BNL ESH Committee:		ETL
The hazard associated with the proposed work is not appropriately included in an SAD.		ETL

Ray Kaiser — 10-22-01

Signature of C-A Committee Chair or C-A ESHQ Division Head — Date

Edward T Lessard — 10-22-01

Signature of C-A Associate Chair for ESHQ — Date

Collider-Accelerator Department

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managed by Brookhaven Science Associates
for the U.S. Department of Energy

Memo

date: *July 21, 2000*

to: *W. Glenn*

from: *J. Alessi*

subject: *Tandem MP6 bypass ASSRC walkthrough*

The MP6 bypass line is now near completion and ready for a final walkthrough by the ASSRC. The committee concerns regarding the MP6 upgrade, from the 11/9/98 memo from Glenn and Bower, have been addressed as follows:

1. No magnetic fields above acceptable limits – a magnetic field survey of the accelerator room was done by Bernholc on 4/10/91 (memo N. Bernholc to T. Robinson 6/5/91), where measurements were made of a 90 degree analyzer dipole, the injector inflector magnet, a high energy quadrupole magnet, the switcher magnet, several steering dipoles, and transport line quads. Whole body exposures and extremity exposures were determined to be below TLV limits in all cases. Levels were found above 10 G, and the accelerator room is thus posted with the pacemaker/implant warning. All magnets in the new line are essentially the same types as those previously measured, so we feel that no further measurements are required.

2. Radiation Safety Committee review of the logic of two tandems feeding three areas – a RSC subcommittee meeting to review this was held 5/2/2000. The subcommittee reviewed and approved the changes required to the tandem radiation safety system. (Minutes of the RSC sub-committee are attached).

3. Subcommittee of Bernholc, Levesque, and Manni to review SF6 life safety issues, etc. – Bernholc, Levesque, and Manni met on 12/17/98 to review SF6 life safety issues (see attached memo from Bernholc to Glenn). While SF6 life safety was addressed to some extent in the Tandem SAD (1995), there are issues which need to be investigated further, and L. Snydstrup is now in the process of continuing some of the calculations begun by Manni. We could consider a temporary measure such as classification of the accelerator room and basement area as an ODH 0 area until the detailed analysis is complete.

4. Exposed electrical terminals in the accelerator room – all exposed terminals have been covered. The question of the need for a roof over the source cage is as yet unresolved, but has been discussed with J. Sandberg and will be resolved.

5. A noise survey when bleeding a tank to air after evacuation – L. Stiegler performed the noise survey on 5/9/00 (see attached survey form). The conclusion was that hearing protection should be worn by the operator starting the vent. No overexposures were expected based on the survey.

6. Evaluation of the environmental consequences of a large release of SF6 – no further action is required (see attached email from Schroeder to Lessard).

Attachments:

RSC subcommittee minutes, 5/24/2000
Memo from Bernholc to Glenn, 7/21/2000
Noise measurement form, 5/9/00
Email Schroeder to Lessard, 5/4/2000

AGS/RHIC

Radiation

Safety

Committee

Issued: May 24, 2000

Minutes of Sub-Commitee review of May 2, 2000

Review of MP-6 Interlocks with the new Bypass Line

Attending: J. Alessi, A. Etkin, M. Wiplich, C. Schaefer, and D. Beavis

Motivation: A new beamline has been added to MP-6. This allows MP-6 to deliver beam to the target rooms 2, 4 and to HITL. Previously only MP-7 was capable of delivering beams to these areas. The sub-committee reviewed the logic for the changes necessary for the area changes.

The sub-committee approved the proposed changes.

Documentation was provided to the committee by J. Alessi and M. Wiplich (see attachments 1-3).

Changes to the MP-6 Low energy (LE) and high energy (HE) cup controls are necessary for the radsafe system to turn the beam off. These changes have been reviewed and an ECN issued.

The proposed logic for the conditions to interlock MP-6 was discussed. The new logic takes into account that MP-6 can now be a source of radiation (beam) to target rooms 2,4, HITL, and the MP-7 area. The radsafe system response matrix was reviewed and approved. An ECN will need to be issued for the wiring changes necessary to implement the new logic. **(CK-Tandem-2000-1)**

A chipmunk will be installed near the new bypass slits to provide better area radiation monitoring with the bypass line. **(CK-Tandem-2000-2)**

There is a concern that the present use of radiation monitors may not adequately cover all the potential radiation sources. Under certain operating conditions the tandem operator can allow personnel into various zones. During such accesses the radiation levels at the various detectors must be below 50 mrem/hr for the machine can operate. Detected radiation levels above 50 mrem/hr will cause the appropriate safety devices to terminate the radiation. However, an examination the possible source locations suggests that the radiation detectors are not located close enough to all potential sources. The committee recommends that this mode of access not be used if there is the potential for high radiation levels. **(CK-Tandem-2000-3)** A study using MP-6 should be conducted during its commissioning to understand if there is a need to permanently modify this access mode. The tandem operators presently use a computer program, which evaluates if there is the potential for high secondary radiation.

The new bypass line can create beam faults in new locations within the accelerator room. Faults with a deuteron beam at 9DH01 or 7DH01 could cause levels in the HITL tunnel. Deuteron beam should not be allowed in the new bypass line until either calculations for such faults are reviewed, a fault study conducted, or appropriately approved protection means are provided in the HITL tunnel. **(CK-Tandem-2000-4)**. It is expected that these faults are not much higher than the fault study conducted with the MP-7 beam hitting 11DH01.

Deuteron beams may have the potential to create radiation levels above 50 rem/hr. The access controls for the areas may not meet the required standards of independent interlock systems for radiation levels above 50 rem/hr. Therefore, deutron beam should not be operated from either MP-6 or MP-7 until an appropriate review is conducted of the potential radiation levels. **(CK-Tandem-2000-5)**

The critical devices for the tandem should have an engineering review conduct before the next operating cycle. **(CK-Tandem-2001-1)**

Attachments:

1. Memo J. Alessi to D. Beavis, April 25, 2000, "Tandem Radiation Safety System
2. Memo M. Wiplich to RSC, April 25, 2000, "Upgrades to TVDG radsafe System".
3. Memo M. Wiplich to RSC, April 25, 2000, "Rewiring of MP-7 HE and LE Cup Controls"

Prepared by: J. Alessi
Date: June 7, 2000

Reviewed by: (RSCR)
Date: 6/8/00

Approved by: (Dept. Chair)
Date: 6/8/00

TANDEM BYPASS RADIATION SECURITY CHECK-OFF LIST

June 7, 2000

Prior to operation of the Tandem bypass line with beam, the following items must be completed:

(TE) An ECN has been issued for wiring changes to the Tandem radsafe system.

(TE) Modifications to the Tandem radsafe system for delivery of beam from MP6 into target rooms 2, 4, and HITL have been implemented and functionally tested.

(TE) A chipmunk has been installed near the bypass midpoint slits and tied into the radsafe system.

(PGL) A memo has been issued instructing Tandem operators to prohibit access to the accelerator room when running any beam capable of producing radiation in excess of 50 mR/hr. These beams are indicated by the radiation-warning message in the tandem setup program.

(PGL) A memo has been issued instructing Tandem operators not to operate either MP6 or MP7 with protons or deuterons.

TE Tandem Engineer
PGL Preinjector Group Leader
RSCR Radiation Safety Committee Representative

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BROOKHAVEN
NATIONAL LABORATORY

managed by Brookhaven Science Associates
for the U.S. Department of Energy

Memo

date: *July 21, 2000*

to: *W. Glenn*

from: *N. Bernholc*

subject: **Tandem Van de Graaff MP-6 Upgrade -Life Safety Issues Surrounding the SF6 gas System**

This is a revision of a draft report regarding the SF6 gas System in the Tandem Van de Graaff MP-6 Upgrade . On December 17, 1998, J. Lesveque, M. Manni and I met to discuss the life safety issues regarding the SF6 gas system. We discussed and reviewed existing procedures and equipment that were currently in place to prevent hazards from the Sulfur Hexafluoride (SF6) gas system. On July 21, 2000 I met with L. Snydstrup and J. Alessi to further refine and clarify the draft.

The following specific items that were covered includes:
1) Toxicity of SF6

The threshold limit value (TLV) and PEL designated by ACGIH and OSHA for SF6 is 1000 ppm. Sulfur hexafluoride is a colorless, odorless gas. Pure SF6 is chemically inert, however it is often contaminated with lower fluorides such as sulfur pentafluoride and sulfur tetrafluoride. This can be due to heating or sparking, or produced as a byproduct of sulfur hexafluoride production. These fluorides are very toxic and have ceiling TLVs of 0.1 ppm and 0.01 ppm respectively. (See attached appendix).

Existing precautions in place:

a) The material used in the Tandem Van de Graaf has was tested (both analytically and with animal testing) in 1992 and determined that no contaminants were present. It was tested again in 1998 but at a higher detection level. Plans are in place to retest the material to meet the above criteria.

b) The insulating gas is constantly circulated through activated Alumina drying towers specifically to remove residual water vapor. A side benefit is that the Alumina is likely to act as an effective scrubber for toxic decomposition products from the SF6.

c) Although SF6 is nonflammable, some decomposition is to be expected at high temperatures in the presence of oxygen, with the release of highly toxic and irritating decomposition products.

   i) Conditions that cause sparking are not the same as those conditions that are likely to cause a window failure.

   ii) If a rupture of the vessel occurs or some component (e.g. chain breakage), then

the vessel will shut down.

Because of these factors we believe that we are dealing primarily with an asphyxiation hazard.

2) Current Detection systems
   a) The current detector system is a Miran SF6 detector. It is equipped with 12 sensors stationed at 12 locations through the building. They are placed at points where the gas is expected to accumulate and where initial leakage is expected to occur. The detectors are currently set at 100 ppm, though they can be set as low as 10 ppm. It is expected that these detectors will alarm in the event of a release.

   b) Oxygen deficiency detectors and also located through the building providing a redundant alarm indication. These are set to alarm at levels $\leq$ 19.5% oxygen.

      i) Precautions

         (1) Both these detector systems are independent of each other. Each system has it's own calibration and maintenance schedule. It is unlikely that they would both fail at the same time. The SF6 detector will start to alarm at a much lower level than the oxygen deficiency detectors.

         (2) Calculations have been made that even if the system ruptured, it would take 30 minutes to release 90% of the material into the room.

         (3) There is a protection factor of 10 was built into the design of the vessel windows to protect against breakage. In addition the windows are covered with a protective shield when not in use.

         (4) It is believed that the rupture will cause a loud noise that will attract the attention of the control room operator.

         (5) Note: Formerly the procedures required the presence of two operators in the control room at all times. This procedure has been changed to one operator based on comparison to G-2. Call in is not required for the Tandem operator. I am not clear that the scenarios are identical and suggest that this be revisited based on the following questions a) what is the potential for release in the control room (ODH class?) b) does the operator go on tour/inspections and have the potential for entering a hazardous environment? C) Is there need for the operator to wear personal ODH devices?

2) Ventilation system
   a) The probability for a major release is small. If this scenario should occur, a release of 180, 000 SCF of insulating gas mixture (Note1) comes into the accelerator rooms which would cause an asphyxiation potential if personnel are within that area or working in the Pit areas under the accelerator vessels. It is expected that the SF6 Miran system and Oxygen deficiency monitor will alarm. The operator will then turn on the emergency purge fans which exhaust air from the room at a rate of 23,000 CFM. for air. If this was normal air you would expect an air change at least every 12.14 minutes. * Note2: See section b.

- Note 1: Insulating gas mixture for MP7 consists of approximately 50%SF6 41.2%N; 3.8%CO2, and

5%O2.

b) The system will have to be upgraded to handle the higher density gas. The fans have never been tested in the presence of SF6 to see if they are able to hold up to The ventilation system has never been actually tested to purge SF6. Since SF6 is so dense, it is not clear if the motor can handle this gas. M. Manni will look into this. The motors of the fans used inside of the Tandem Van de Graaff are not found in the tanks, rather they are belt driven. The gas does not pass through the motor.

c) It is assumed that the emergency fans will be turned on manually. If they are not, then normal ventilation consists of recirculated air handling system. Further calculation must be made to determine the ODH classification of the areas.

3) Emergency procedures – Appendix II
   a) If there was a release, M. Manni has calcuated that the time to empty the vessel from 225 psig to 1 atmosphere is 30 to 45 minutes thru a 3" diameter window opening. .
   b) Consider changing the procedures. If an evacuation is required, first evacuate the premises and then make the emergency calls.
   c) Additional changes may include having an automatic alarm to either fire rescue or to the police department.
   d) If a release occurs, the fire rescue and police department must be notified. When they are notified, response procedures for this scenario should be developed (call lists, etc). This should include notification of confined space users and accessible basement areas in the vicinity outdoors or downhill from the Tandem and the exhaust ventilation .

Attachments: ACGIH Documentation for TLVs for sulfur tetrafluoride and sulfur pentafluoride

IH 60SR.00
J. Alessi
J. Lesveque
R. Selvey
L. Snydstrup
O. White

* * *

BROOKHAVEN NATIONAL LABORATORY

MEMORANDUM

AGS Accelerator Systems Safety Review Committee

DATE: November 9, 1998

TO: ASSRC Members and Guests

FROM: J.W. Glenn, L.Bower

SUBJECT: ASSRC Review of Tandem VandeGraaff MP-6 Upgrade, 10/29/98

Members: J. Alessi, N. Bernholc, L. Bower, J. Cullen, J.W. Glenn, P. Ingrassia, J. Levesque, R. Thern, D. Phillips, J. Sandberg, W. Sims, J. Spinner, J. Tuozzolo

Guests: C. Carlson, J. Benjamin, P. Thieberger, M. Manni, M. Zarcone, Michael Wiplich

Carlson presented an overview of the upgrade. Facts presented:
The upgrade is in progress – this is the same work that was done on MP-7.
The previous maximum voltage was 12.5 Mv, the upgrade capability will be 16.5 Mv.
Magnets 1-4 will be delivered by 12/31/98.
The optics were finalized on 10/26/98
The vessel was pressure tested to 220 psi with N_2, it is rated at 300 psi, and the reliefs are set at 250.
The fire risk is reasonable, with a fire causing only a few days of shutdown.

The committee then did a walkthrough in the Accelerator vault.

Concerns:

1. The accelerator room is already posted for magnetic fields – however, a survey should be done to determine if there are any exposures above the acceptable limits (ACGIH TLV of 600 G for 8-hour TWA, 20,000 G ceiling whole body). Bower to report to the Committee.
2. The Radiation Safety Committee should review the logic with two tandems feeding three areas. (RSC)
3. A subcommittee of Bernholc, Levesque, and Manni will review life safety issues regarding the SF6 gas system, such as purge fans emergency power; crash button number and location; asphyxiation danger if the control room is unattended. What procedure or hardware changes are necessary?

4. The devices in the accelerator room need to all have covered terminals since LO/TO is not required before entering. The source cage roof is off. Sandberg will determine if it needs to be in place before operation.
5. A noise survey should be done for venting an evacuated tank to air. Bower to report to the Committee.
6. The Environmental Protection Office and/or Emergency Planning office needs to evaluate the environmental consequences of a large release of SF6. Lessard to report to the Committee.

Copies of these reports will be distributed as a package on completion. If requested by the committee, there will be a second walkthrough.

Cc: Members, Guests, and D Beavis.

Responses To Accelerator Safety Systems Review Committee Checklist For MP-6 Upgrade

Cryogenic Devices

All cryogenic devices. Certain devices are subject to review by the BNL Cryogenic Safety Committee (see ES&H Standard Section 5.0).

Small amounts of liquid nitrogen (< 1-gallon quantities) will be used in the cold traps of the helium leak detector during leak checking. It is not anticipated to use any other cryogenic devices that have not been previously used or are currently in use. It is not anticipated that any cryogenic devices will require review by the BNL Cryogenic Safety Committee.

Combustible/Flammable Materials

Use of flammable gasses.

The use of flammable gasses is not anticipated.

Combustible liquids used in quantities exceeding 1 gallon, or in any quantity if the flash point is less than 100 ° F (see ES&H Standard 4.10.0).

The use of combustible liquids in quantities exceeding 1 gallon or liquids whose flash point is less than 100 ° F is not anticipated.

Equipment or material containing woods, plastic, paper or other combustible matter in significant quantities.

The use of material containing woods, plastic, paper or other combustible matter in significant quantities is not anticipated.

Compliance with Life Safety Code.

The MP-6 upgrade project has been inspected and reviewed by J. Levesque and J. Eckroth and found to be in compliance with the 1992 Life Safety Code.

Compliance with Improved Risk level of fire protection (see ES&H Standard 4.0.0).

The MP-6 upgrade project has been inspected and reviewed by J. Levesque and J. Eckroth and found to be in compliance with the Improved Risk level of fire protection.

Electrical

Fusing and other protective circuitry in equipment.

All fusing and protective circuitry has been designed to and will be installed in accordance with applicable industry standards.

Controls and indicators (including emergency off controls for power).

Controls and indicators including emergency off controls for power are in conformance with existing controls and with applicable industry standards.

Conformance of procedures for electrical safety.

The MP-6 upgrade project procedures are in conformance with procedures for electrical safety.

Conformance to OSHA control zone, lockout and interlock requirements.

MP-6 upgrade project activities are in conformance with OSHA control zone, lockout and interlock requirements.

Requirements for emergency power (including maintenance procedures).

Requirements for emergency power are minimal and confined, primarily, to emergency lighting. Maintenance procedures for these devices are in place.

Protective barriers. Use of low voltage control circuitry and exposed electrical terminals.

Protective barriers are used at this facility when required. Control circuitry uses low voltage wiring in conformance with applicable industry standards.

Hazardous Chemical, Oils or Solvents

Any substance with a Threshold Limit Value (TLV) of less than 350 ppm.
It is not anticipated to use any substance with a Threshold Limit Value (TLV) of less than 350 ppm.

Any substance (>1 gallon) which on immediate or prolonged contact with tissue will cause injury.
It is not anticipated to use any substance in quantities greater than 1 gallon which on immediate or prolonged contact with tissue will cause injury.

Environmental

Any material release with present environmental considerations.
No material release with present environmental considerations is anticipated.

Any appropriate permit required.
None required.

All appropriate required environmental reviews; e.g. NEPA.
All appropriate required environmental reviews as covered by AGS/DOE EA#0909 have been completed.

Hazardous waste in compliance with AGS/BNL Hazardous Waste Accumulation Area requirements.
Hazardous waste is in compliance with AGS/BNL Hazardous Waste Accumulation Area requirements.

Radioactive waste disposal in compliance with AGS/BNL policy.
Radioactive waste disposal is in compliance with AGS/BNL policy.

Clean waste disposal/recycling practices in compliance with AGS/BNL policy.
Clean waste disposal/recycling practices are in compliance with AGS/BNL policy.

Toxic and hazardous materials storage.
Toxic and hazardous materials use and storage practices are in compliance with AGS/BNL policy.

Temperature, Lasers, RF (including microwave), Noise and Magnetic Fields

Any equipment which has exposed surfaces less than 0 °F or greater than 150 °F.
None anticipated.

Radio frequency or microwave radiation field generated by a source greater than 25 watts in a space that might be occupied.
None anticipated.

Lasers with power greater than 1 mW.
None anticipated.

Noise in occupied areas in excess of 85 dbA sound pressure level.
Occupied areas have been tested during most noise generating activities. Sound pressure levels in occupied areas have been found to be below 85 dbA. The tank venting operation has yet to be tested.

Magnetic fields with fringe fields greater than 5 gauss at a distance of one meter from magnet face.
None anticipated. The magnets used in this project are of the same design as those used in the HITL/HTB project. Refer to the HTB SAR for information concerning stray magnetic fields.

Ultraviolet lamps.
The use of ultraviolet lamps is not anticipated.

Mechanical

All vessels which are operated more than 15 psi above or below atmospheric.
It is not anticipated to exceed previously attained pressures in any vessels. These pressure vessels are code stamped, meeting ASME Boiler and Pressure Vessel Code, Section VIII, Division I, with a maximum rated pressure of 300 psig. Vessels were hydrostatically tested to 450 psig prior to installation. A 250 psig pressure relief valve is located on the main gas fill line. A 250 psig pressure relief valve has been installed on each pressure vessel.

Any material handling devices including all larger moving equipment.
No material handling devices or moving equipment whose inspection is not current will be used. The cranes were inspected in June, 1998. The rigging equipment inspections are current as per PERM procedure number 096.

Structures supporting heavy loads.
It is not anticipated to use structures supporting heavy loads that have not been previously or are currently in use.

All aspects of compressed gas systems; for example, types of regulators and line pressures.
It is not anticipated to have compressed gas systems that have not been previously or are currently in use.

Structures or devices influenced by magnetic push or pull.
It is not anticipated to have devices influenced by magnetic push or pull that has not been previously or are currently in use.

Auxiliary Systems

Electrical power including voltage, power and present power system alterations to supply accelerator system.
It is not anticipated to use voltages and power levels not previously or currently in use. No unusual alterations to the electrical power distribution system are anticipated.

Mechanical services including cooling requirements and media, pressures, flow and present cooling system alterations to supply accelerator system.
It is not anticipated that cooling requirements and media, pressures flow and present cooling system alterations will be significantly different from those previously or currently in use.

Civil work including new construction and/or alterations to present buildings.
It is not anticipated that any new construction or alterations to present buildings will be significantly different from what has previously or currently been done.

Procedures

Emergency.
No significant changes are anticipated in emergency procedures. Response procedures include MP-6.

Operating procedures.
No significant changes to operating procedures are anticipated for MP-6. New procedures will be generated for bypass line operation and added to the TVDG OPM.

Maintenance procedures.
No significant changes to maintenance procedures are anticipated for MP-6. New maintenance procedures will be generated and added to PERM.

Training requirements.
No significant changes to training requirements are anticipated for MP-6. MP-6 procedures are anticipated to be identical to those for MP-7. Procedures for the bypass line will be generated and added to the TVDG OPM.

Other